PARI

Parkland Agriculture Research Initiative

CANADA'S GREEN PLAN

103-00225/

PROCEEDINGS

of the

PARI WORKSHOP

Bringing Conservation Technology to the Farm

Edited by:

H. M. Plas, E. G. Smith and C. W. Lindwall
on behalf of the Steering Committee

Conservation Workshop
November 26-28, 1995

Delta Bessborough
Saskatoon, Saskatchewan

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Plas, H. M., Smith, E. G. and Lindwall, C. W., (eds.) 1995. Proceedings of the PARI Workshop: Bringing Conservation Technology to the Farm, Saskatoon, SK. November 26-28. Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB. 41 pp.

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PARI Workshop Final Program

Bringing Conservation Technology to the Farm

Sunday November 26, 1995

7:00-10:00 p.m.	**Registration & Welcome Reception,** William Pascoe Room

Monday November 27, 1995

7:30 a.m.	**Registration,** Battleford Room
Session Chair:	**Barry Grace,** Agriculture and Agri-Food Canada, Ottawa, ON
8:30 - 8:45	**Welcome and Opening Remarks** Wayne Lindwall, Agriculture and Agri-Food Canada, Lethbridge, AB
8:45 - 9:30	**Keynote Address: Information Technology in Agriculture** Dan Cornish, President, Red Deer College, Red Deer, AB
9:30 - 9:50	**The W5 of PARI** Wayne Lindwall, Agriculture and Agri-Food Canada, Lethbridge, AB
9:50- 10:10	**PARI Decision Support Systems** Murray Bentham, Agriculture and Agri-Food Canada, Saskatoon, SK
10:10 - 10:40	**BREAK**
10:40 - 11:00	**PARI Research Component: Research on Sustainable Soil/Cropping Systems** Dave McAndrew, Agriculture and Agri-Food Canada, Morden, MB
11:00 - 11:20	**Monitoring Land Use With Remote Sensing and GIS--Geographic Information Systems** Gerald Coen, Agriculture and Agri-Food Canada, Edmonton, AB
11:20 - 11:40	**Putting Research to Practice: Conservation Demonstration Farms** Wayne Lindwall, Agriculture and Agri-Food Canada, Lethbridge, AB
11:40 - noon	**Discussion**
noon -1:15	**LUNCH**, Adam Ballroom
Session Chair:	**John Hermans,** Alberta Agriculture, Food and Rural Development, Edmonton, AB

1:15 - 3:00 **Challenges and Opportunities for Information Development and Transfer: Panel Discussion**
Ken Eshpeter, Producer, Daysland, AB
Glen Hass, Organization Management Services, Saskatoon, SK
Adrian Johnston, Agriculture and Agri-Food Canada, Melfort, SK
Ray Dowbenko, Sherritt Fertilizers, Edmonton, AB

3:00 - 3:30 **BREAK**

3:30 - 5:00 **Break-out Sessions**
I Computer Software Demonstrations
(Kelsey Room, Saskatchewan Room, Salon Batoche)
II Poster Presentations
(Convention Floor Foyer, Terrace Lounge)

5:30 - 6:00 **Reception and Cash Bar,** Adam Ballroom

6:00- 8:30 **Banquet,** Adam Ballroom Guest Speaker: Dr. Gordon Dorrell, Director General, Western Region, Agriculture and Agri-Food Canada, Ottawa, ON

Tuesday November 28, 1995

Session Chair: **Peter Burnett,** Agriculture and Agri-Food Canada, Lacombe, AB

8:30 - 8:50 **Integration of Agriculture, Environment and Wildlife**
Lee Moats, Ducks Unlimited Canada, Regina, SK

8:50 - 9:10 **Conservation Tillage: Looking Into The Future**
Guy Lafond, Agriculture and Agri-Food Canada, Indian Head, SK

9:10 - 9:30 **Global Positioning Systems (GPS): Monitoring and Controls**
Murray Green, Alberta Agriculture, Food and Rural Development, Airdrie, AB

9:30 - 9:50 **Precision Farming**
Doug Penney, Alberta Agriculture, Food and Rural Development, Edmonton, AB

9:50 - 10:00 **Discussion**

10:00- 10:30 **BREAK**

10:30- noon **Break-out Sessions**
I Computer Software Demonstrations
(Kelsey Room, Saskatchewan Room, Salon Batoche)
II Poster Presentations
(Convention Floor Foyer, Terrace Lounge)

noon - 1:15 **LUNCH,** Adam Ballroom

Session Chair:	**Paula Brand,** PFRA, Calgary, AB
1:15 - 3:00	**Future Direction of Conservation on the Parkland: Panel Discussion** John Bennett, Producer, Biggar, SK Eric Johnson, Saskatchewan Agriculture and Food, North Battleford, SK George Clayton, Agriculture and Agri-Food Canada, Beaverlodge, AB Terry Roberts, Potash and Phosphate Institute of Canada, Saskatoon, SK
3:00 - 3:30	**PARI: Where Should We Be Headed?** Don Flaten, University of Manitoba, Winnipeg, MB
3:30	**Adjourn**

PARI Partners

Agriculture and Agri-Food Canada
Alberta Agriculture, Food, and Rural Development
Ducks Unlimited Canada
Saskatchewan Agriculture and Food
University of Alberta
University of Saskatchewan

Information: Key To Adopting Conservation Management In Agriculture

Dan Cornish, Red Deer College, Red Deer, AB

Introduction

Thank you for the opportunity to open your Conservation Workshop here in Saskatoon this morning. I have had the opportunity of participating like this with similar groups over the past few years. It is a privilege to speak with you this today.

This morning I will talk very little about conservation management. What I have to say will be context to the challenges you face in implementing and managing conservation practices on your farms. I will reflect for a few moments on change, its rapidity and the overwhelming flow of data which this change produces. We will then examine how attitudes and certain skills are essential ingredients for managing information in the context of your lives as stewards of the soil and, more broadly, managers of conservation practice.

Let me share an initial bias of mine. Your primary challenge is not becoming convinced of the need to conserve. I have yet to meet a farmer who practised erosion or misuses of resources because they thought it was the right thing to do. Failure to engage in such practice was often the result of economics, policy, lack of information, lack of skill but seldom lack of will. So I want to propose to you this morning that a major issue in successful conservation management is information acquisition and management.

Now, quickly a second bias. Information itself and the related technology is NOT the answer. Technology is the TOOL. What comes first is the attitude toward data and the skill to translate it into useful information. But, I am getting ahead of myself. Let me make my point with two short stories about change. Change is not only very rapid but much of what is happening is discontinuous; it is not connected to that with which we are familiar. This need not lead to disaster although it can. The Peruvian Indians are good example of attitude and information mixing in the wrong way. They saw the sails of their Spanish invader on the horizon and thought the sails were a freak of the weather. They had no concept of sailing ships in their experience so they went about their business. They assumed continuity, screened out what did not fit and let disaster in. Now disaster might have still occurred, but for certain the Peruvians would have acted very differently if they had perceived the sails from a different perspective.

The flip side of continuity is in the story of a frog if put in cold water will not stir itself if the water is heated slowly and gradually and will in the end let itself be boiled alive, too comfortable with continuity to realize that continuous change at some point may become intolerable and demand a change in behaviour. If we want to avoid the fate of both the Peruvians and the frog we must confront and deal with change. We must develop the attitudes, skills and information management abilities to engage and shape the changes around us.

Let me talk just a little more about our Information context. Then I would then like to discuss the nature of business and provide some definition of information and related tools. I do not want to be pedagogical about this, but I think it is important for us to understand what we are talking about. Just before concluding, I will discuss the main features of knowledge-based business Finally, in the last few minutes, we are going to open a node on the information highway and show you the kind of information available over an ordinary telephone line.

I really enjoy these opportunities because they give me a chance to look back at what I have said on this topic earlier. I do recall in one of my earlier speeches, I talked about information. At that point, I observed the issue of information was so complex and far-reaching that we could no longer leave it as the responsibility of individual farmers. I believed the creation of extension departments in agricultural ministries and in agriculturally based universities, was a reflection of the difficulty associated with developing and disseminating critical information. I thought then that information was a "public good," almost like a utility, requiring primary involvement of government.

The context has changed radically. This is not to suggest that working together and seeking the assistance of organizations, like Ministries of Agriculture and post-secondary institutions should stop. Today it is clear that information is a commodity and there is great interest in managing that commodity to create additional wealth. In fact, the view of information as a commodity means it must be available so users can apply that information in a timely and cost-effective way to their own circumstances. Adding more complexity is the fact that, traditional developers and disseminators of information are no longer the sole source of information. The responsibility for acquiring and manipulating that information now rests more in your individual hands. Fortunately, it is now possible for access to be available to individuals.

The Nature of Business

Now let me reflect briefly on the nature of today's business environment. These thoughts come from two articles by Peter Drucker, "The Theory of Business" and "The Information Executives Truly Need" in the September/October '94 and the January/February '95 issues of The Harvard Business Review. Let me highlight some of Mr. Drucker's points.

First, every organization, whether a business or not, has a theory about their business. Such a theory has three sets of assumptions about the organization's **environment,** its specific **mission** and third, assumptions about the core **competencies,** needed to accomplish the mission of the organization. In effect, assumptions about environment define what an organization is paid for. Assumptions about mission define what an organization considers to be meaningful results. These assumptions about mission define how an organization sees itself making a difference in the economy and society at large. Finally, the assumptions about core competencies define where the organization must excel in order to maintain leadership.

There are four specifications to meet if these assumptions are to represent a valid theory of business. First, the assumptions about environment, mission and core competencies must fit

reality. Secondly, the assumptions in all three of those areas: environment, mission and competencies must fit one another. The third specification is that the theory of business must be known and understood throughout the business itself. Whether it is a small family farm or a large corporate organization, everyone must understand the theory underpinning the organization's operation. Finally, a theory of the business is an hypothesis about reality; it must be constantly examined.

Pointedly, Drucker observes that often when an organization's theory is becoming obsolete, its almost automatic reaction is to be defensive, suggesting a strong need to rethink the firm's theory. To avoid these kinds of problems, we need to undertake two specific activities. He calls the first measure **"Abandonment,"** and suggests that every three years, any organization should challenge every part of its service policy or distribution channel with the question, **"If we were not in it already, would we be going into it now?"**

The second preventative suggestion is for us to pay very serious attention to what is going on outside the business. The first signs of fundamental change in a business rarely occur within one's own organization. Fundamental change almost always shows up with noncustomers.

You may feel this analysis does not apply to your business. I am strongly convinced that ALL forms of organization, complex or simple, profit or non-profit, face the same challenges that Drucker identifies.

Information Tools and Business

Drucker's second article discusses information tools. Remember, as we examine at these tools, that enterprises are paid to create wealth, not control, costs. Of course, to be involved in effective wealth creation requires information that enables us to make informed judgments. There are four sets of diagnostic tools.

Foundation Information involves such diagnostic tools as cash flow and liquidity projections. They are likened to the measurements a doctor takes in a routine physical; weight, pulse, temperature, etc.. If the readings are normal, they tell us things are OK. If they are abnormal, a problem is indicated which needs to be identified and treated. You need to determine in your business what the foundation kind of information is. It needs to be collected, analyzed and treated on a deviation basis.

Productivity information deals with the productivity of key resources. The oldest of these measures the productivity of manual labour. The real pressure is to develop measurements which assess the productivity of knowledge-based service work. The simple fact, however, is that we cannot just look at the productivity of individual pieces. We must seek to understand total factor productivity. More can be said on costing. Pressure is strong to engage in total economic chain and price-led costing. Today's presentation does not permit the time.

Competence Information is the core cability required to meld market or customer value with the special nature of the producer or the supplier. Niche skills or niche markets are easy to identify as a need. It is not an easy thing to do. The first step might be to keep careful track of your own, or your competitor's, performance, looking especially for unexpected successes and unexpected performances because they demonstrate what the market values. Unexpected failures should be viewed as an indication that the market is changing or that your competencies are weakening and need to be fixed.

Recognize that core competencies are different for every organization, but the one competency required of every single organization is **innovation.** Every organization needs to carefully record innovations, and seek to understand what prompted their success.

Resources Allocation Information focuses on the allocation of scarce resources: capital and performing people. These two convert into action whatever information you have about your business. These resources determine whether or not your organization will be successful.

Capital, however, is not the scarcest key resource in your organization, although I suspect those of you have to find financing on a regular basis may want to argue. **The scarcest resource in the organization is performing people.** Growing sources of information and the skills to use the information make this assertion even more true today.

These four kinds of information tell you about your current business. Such information, regularly used is absolutely vital. Nonetheless, information is needed about the environment.

Strategic Information guides the direction of your business. Reflect on my earlier comments about the theory of your business. To pay attention to the surroundings of your business you must have information about your environment. This is the strategic information you need to assess direction and focus, in a word, to survive. Strategic information is based upon information about:

- markets;
- customers and non-customers;
- technology in yours and others business;
- world wide finance; and
- the changing world economy.

Let me talk now about knowledge based business by noting that even big companies have to hire outsiders to help them with the analysis of all this information. What most enterprises need to know about the environment is available from outside sources such as data banks, data services, journals, trade associations, government publications, scientific papers and specialized studies. Help is needed to organize this information and turn it into knowledge.

Further, outside help is usually useful because information needs to be organized so that it questions and challenges your strategy. There is an emerging field of software that organizes data into information for particular industries, but at the same time, raises the key questions about the use of the information, the user's business practices and, in some cases, may provide interactive consultation.

KNOWLEDGE BASED BUSINESS

According to an article by Davis and Butkin in the September/October 94 issue of Harvard Business Review, the next wave of economic growth is going to come from knowledge based businesses. Such businesses produce smart products which are interactive, able to become smarter the more they are used and thus able to provide a range of responses for customers. Smart products also create customers who become learners when they use these smart products. Businesses will move toward making their offerings smarter, because they will profit from doing so.

Herein lies a radical shift in thinking. Businesses will see customers as learners and themselves as educators. The value of businesses will be determined by the information they provide and the subsequent extent to which their customers become learners. Those businesses which provide information to customers will have an advantage over those that do not.

Let me be more specific about what we mean when certain terms are used.

Data are the basic building blocks of the information economy and of a knowledge based business. Data are the unorganized sludge of the information age. They come to us in four particular forms: numbers, words, sounds and images. What we do with data, how we process, store, or manipulate them, determines their value to us.

Information is data which has been organized or arranged into meaningful patterns. Sounds converted into notes are data that can be arranged in an infinite number of systems to produce the information that we call music. Whether a piece of music becomes the stuff of knowledge - whether, that is, it enables us to hear it to learn - depends not only on the composition, but on the skill of the performer.

Knowledge is the application and productive use of information.

We are moving through at least one critical shift, from a data to an information economy. Data today are commodities, neither as powerful nor as valuable as the information derived from them. We are witnessing the change where data shifts into information.

This shift has produced a technological and a behavioural development. The technological shift involves our ability to manage the array of information with computers and new systems. However, only after technology has been applied in many organizations do we recognize the need for a new way of working with each other. When data and information can now be retrieved with

the punch of a key, you can no longer treat each other the same way when it took days and weeks to do the same thing. To do so, is a gross misuse of the most scarce resource we talked about earlier.

The shift from information to knowledge is equally significant. We are now concerned with ways of purposely and meaningfully using information. This shift is highlighted by an awareness that the value of knowledge exceeds our ability to extract it from the goods and services in which it is embedded. What value is embedded in the information we have and how do we extract it so knowledge develops? How do we acquire, organize and apply information to produce the knowledge and subsequent value needed to sustain our environment and our future? This is the huge challenge!

Specifically, how can businesses extract knowledge and value from a pair of socks, a home mortgage and electric bill, or a foreign exchange credit? Those businesses which figure this out will derive as much power and profit as data and information brought in their turn. While we will not solve this challenge today, it would help to understand the basic elements of a knowledge based business.

ELEMENTS OF KNOWLEDGE BASED BUSINESS

The more you use knowledge based offerings, the smarter they get.

In simple terms, knowledge based offerings help you learn more about your customers and enable that new information to be put into productive use.

An example of this approach would be for banks to collect and report financial information so that patterns could be recognized, or so that the information would occur on a periodic basis consistent with analysis of your business rather than just a listing by date of the transactions. These are examples of knowledge based systems allowing both you and them to become smarter as the system is used.

The more you use knowledge based offerings, the smarter you get.

The computer aided management system developed by General Motors for novice mechanics to diagnose and repair cars has evolved into an extremely sophisticated system that allows expert mechanics to refine their skills. It allows every mechanic to benefit from the combined experience of all mechanics on the system.

This is not unlike the system recently developed by Massey Ferguson to assist farmers in the traditional guesstimate which occurs around the average yield of an entire field. Massey's yield mapping system enables farmers to practice small scale farming on a large scale and maximize the yield of each square yard in every field. It links a tractor to a satellite based global positioning system which records latitude, longitude and yield of every square yard of the field. The data goes to a desktop computer which generates the yield map showing variations above and below

target. Armed with this information, the farmer can investigate selected areas; pinpoint the reasons for variation (soil compaction or nutrient imbalance, as examples); quantify them in financial terms and find out if it is economical to implement remedies. This would enable soil sampling to be much more selective than it is using traditional, random methods. This kind of knowledge based system is being used to provide a competitive edge. In fact, some suggest that it may be worth more than Massey Ferguson's primary business in the future. It will be this way, because the more people use that knowledge based system, the smarter it will make them and the smarter it will make the system.

Knowledge based products and services adjust to changing circumstances.

A fixed offering is not as valuable as one that assesses the situation and modifies itself accordingly. Knowledge based systems will have that kind of a knowledge built into them as a tangible element of the product. Good Year has developed a smart tire which contains a microchip that collects and analyzes data about air pressure. Eventually, it may flash a message to the dashboard indicating the need to service a tire.

Knowledge based businesses can customize their offerings.

It should now be evident from these characteristics that knowledge based products and services can determine changing customer patterns, idiosyncrasies and specific needs, thus enabling customization and even more added value.

Knowledge based products and services have relatively short life cycles.

Constant upgrading based on constant diagnosis is the way of the future. Failure to engage in such an activity means that the fundamental tenets of information based or knowledge based systems have been denied. In essence, failure to modify means that learning has stopped.

Knowledge based businesses enable customers to act in real time.

Well, you might say, "Wow, that's all very interesting information. What does it do for me as a farmer, soil manager, manager of the soil?" Simply put, any product or service has the potential to be more knowledge based. Using Drucker's concept, What is the foundation information you need? What is basic data that you need on products that you produce from your operation? What are your questions? What are the ingredients? What are the benefits, such as nutrition, convenience, price, taste of your product or service?

With that data worked into patterns, meaningful for you AND your customers, you then begin to know your business. You have made a step towards using information so you and your customers can gain knowledge and become educated. You have made the move from information to knowledge. The obvious examples of this kind of shift are related to companies which provide television programming and enable access to worldwide data bases. These are the kind of systems

which we are going to take a look at for a few moments. I want to show you examples of information you can acquire and consider using to add value to your products and make them more competitive marketplace.

Let me just conclude by observing that the market for learning is being redefined dramatically to encompass not just formal students, but also lifelong learners. It seems very clear to me that we all face two challenges. We face the challenge to become users of information and life long learners in everything we do. We are also challenged to find ways of incorporating information into the products and services we provide in order to gain all of the advantages of information and knowledge based businesses.

I should note in closing that learning in agricultural economies have often been church led, focussed on children between 7 and 14 years of age, and deemed sufficient to last all the years of one's life.

In industrial economies, learning was government led, the age range of students was between 5 and 22, and was thought sufficient to last for at least one's working life.

In knowledge economies, the rapid pace of technological change means that learning must be constant and that education must be updated throughout one's entire life. People have to increase their learning power to sustain their earning power.

Knowledge is doubling about every 7 years and in technical fields, in particular, half of what students are learning in their first year of college is obsolete by the time they graduate. In the labour force, the need to keep pace with technological change is felt even more acutely. Consumers as a learning segment are as underestimated as the shadow education market reflected by this need to continue to learn. Consumers and people who supply consumers will be the biggest and the largest learning segment in the 21st Century marketplace. Information technologies are becoming more friendly and much smarter, and as they become intrinsic to more and more products and services, learning will become a by-product of the customer's world. I think it's very accurate to say that never before have customers considered themselves learners and businesses considered themselves educators. This is the challenge which faces us today. How do we take our products and services, add information and configure them such that they become a basis for knowledge and learning in our society. Clearly, these are not easy questions, but they are certainly ones we will solve in the closing days of the 20th Century.

PARI Research Component

David W. McAndrew, Agriculture and Agri-Food Canada, Morden, MB

Background

The Parkland Agricultural Research Initiative (PARI) was initiated to develop and demonstrate soil and water conservation technology for the Parkland soils of the prairies. A subcomponent know as the Research on Sustainable Soil and Crop Management Systems (ROSSCS) of PARI was designed to support or enhance on-going research activities in the Parklands. All field based research for this initiative was intended to be conducted in the Dark Brown, Black and Grey Soil Zones. The research was to focus on the elimination of summerfallow from the areas where adequate moisture was available for continuous cropping. Zero-tillage production in most areas targeted was viewed as adequate in most years to ensure a profitable crop. A committee of 13 including researchers, extension specialists, and a producer was established to determine the research priorities and to develop a system to solicit and fund the required research. The committee had representatives from; Agriculture and Agri-Food Canada research staff Lethbridge, Lacombe, Beaverlodge, Saskatoon, Indian Head, Brandon, Morden (committee member transfer from Vegreville in 1994); Agriculture and Agri-Food Canada, PFRA staff soil conservation specialist from Hanna, Alberta; Alberta Agriculture, Food and Rural Development research and extension staff from Edmonton and Smoky Lake; and a producer representative from Daysland, Alberta.

Research Gaps

The following list of research gaps was identified as requiring more research to improve the conservation tillage systems:

1. Weed Control Under Reduced Tillage

- 1.1. Annual or perennial weed populations changes
- 1.2. Economic threshold levels
- 1.3. Comparisons of alternative control measures
- 1.4. Timing and intensity of control measures
- 1.5. Focus on problematic weeds (i.e. toadflax, scentless Chamomile, storksbill, foxtail barley, downy brome, tame brome)
- 1.6. new sprayer technology

2. *Environmental Issues*

- 2.1. Fate of applied pesticides and nutrients
- 2.2. Zero tillage impact on use of pesticides?
- 2.3. Surface and ground water quality?
- 2.4. Pesticide residues on dust and air quality
- 2.5. Herbicide - crop residue interaction
- 2.6. Economic and energy evaluations
- 2.7. Socio-economic evaluation of conservation technology

3. *Soil Quality*

- 3.1. C and N cycling in different systems
- 3.2. How much does wind & water erosion change
- 3.3. Chemical summerfallow vs. conventional
- 3.4. Quantification of tillage effects on soil physical and chemical properties.
- 3.5. Research Gaps (Continued)

4. *Agronomy - Rotational Studies*

- 4.1. Regional effect on tillage, seeding, fertilizer
- 4.2. Air-seeder technology
- 4.3. Interacting of tillage systems with weeds, diseases, insects and crop breeding activities.
- 4.4. Water use efficiency response to tillage system
- 4.5. Crop residue management
- 4.6. Innovative techniques to reduce fertilizer inputs or increase efficiency

Project Selection

There have been three calls - invitations for researchers to submit research projects to address the research gaps identified. Over 40 proposals have been received of which 9 have been funded.

Who is doing what?

1. Three projects have been funded since 1992
   - 1.1. Indian Head, SK Lead by Dr. Doug Derksen
   - 1.2. University of Alberta, Dept. of Renewable Resources, lead by Dr. Cesar Izaurralde
   - 1.3. Alberta Environmental Centre, Vegreville, AB, lead by Dr. John O'Donovan. This project is composed of 4 subprojects one which is conducted at sites in Vegreville, Lacombe and Lethbridge
2. Three projects have been completed
   - 2.1. Swift Current, SK lead by Dr. Bix Biederbeck
   - 2.2. Regina, SK lead by Dr. Allan Cessna
   - 2.3. Vegreville, AB lead by Dr. Dave McAndrew
3. Short-term projects currently underway
   - 3.1. Brandon, MB lead by Dr. Cindy Grant
   - 3.2. Melfort, SK lead by Dr. Allan Moulin
   - 3.3. Saskatoon, SK lead by Dr. Gordon Thomas

Key Issues

All the main issues that were identified as requiring research have been addressed. The research has been conducted throughout the Parkland of the prairies as intended when the program was initiated in 1992.

Next Steps

Most of the research projects funded by ROSSCS had poster or oral presentations highlighting some aspect of the research at the workshop held in Saskatoon, November 27, 29, 1995.

Extension presentations have occurred on nearly all aspects of the research and more are planned in the near future. Some of the research has already had impacts on the other subcomponents of PARI such as the Decision Support System and the Conservation Demonstration Farms Component.

MONITORING LAND USE WITH REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEMS (GIS)

G.M. Coen, P.H. Crown, E.C. Huffman, D.J. Major and L.C. Marciak

INTRODUCTION

The Parkland Agriculture Research Initiative (PARI) is one of the components of the national initiative for *Limiting Greenhouse Gases* under Canada's Green Plan. Increasing amounts of greenhouse gases, such as carbon dioxide, cause increases in mean air temperatures. In order to manage the quality of our environment we need to know how our farming practices influence the levels of greenhouse gases. We know that when soil organic matter levels decrease through oxidation, carbon dioxide is released to the atmosphere. Soil cultivation, and summerfallow, cause oxidation of soil organic matter releasing carbon dioxide and the tractor used in cultivating burns fossil fuels also releasing carbon dioxide. Land use/land cover are indicators of the farming practices being used and thus are useful in predicting the contribution of agricultural land to greenhouse gas levels in the atmosphere.

Soil Resource Monitoring and Evaluation: Adoption of Soil Conservation Practices is one of four initiatives under PARI. Our goal statement at the beginning of the project was to *undertake coordinated studies to develop techniques to determine rates of adoption of soil conservation management practices in the parkland"*. Loosely interpreted we wanted to determine the amount and kind of crop cover and the amount of summerfallow being used in farming systems 20 years ago and again today. This would provide a way to evaluate the changes in farming practices that have taken place over the past 20 years. Process models provide ways to quantify the major factors that govern soil quality and allow us to estimate the influence that various farming practices have on air and soil quality, especially soil organic matter. If we know the factors that reduce the quality of our soils we can then improve the farming practices, and thereby the sustainability of the soil resource. Conserving the soil resource is fundamental to sustainable agriculture and sustaining the environment.

CONSERVATION PRACTICES

Some of the principle conservation practices currently recommended are:

- adjusting the extent and frequency of summerfallow and the type of tillage in order to maintain crop residues at the soil surface,
- incorporating more legume, perennial, and cover crops in the production system,
- constructing structures such as grassed waterways, terraces, and windbreaks to control wind and water movement,

- adopting techniques such as integrated and biological pest control to reduce chemical inputs, and

- purchasing or building equipment specifically designed for resource protection.

The prescriptions necessary to distinguish differing farm practices in the brown and black soil zones in the south and black and gray soil zones in the north of the prairie provinces using remote sensing were shown to be different but the ability to observe conservation related practices was shown to be sufficient to detect and monitor many of the key changes.

REMOTE SENSING

Capabilities

In PARI 2 studies, remote sensing has proven to be a powerful tool for detecting summerfallow (including estimates of residue cover), cereals, canola and permanent cover on farm and field sized parcels of land. By examining satellite images of the same field several times in the same season we can predict the kind of land use in the field (Huffman and Unrau 1995, Fig. 1 or 2; Klita and Crown 1995; Smith et al. 1995). Thus remote sensing is potentially a very powerful tool to evaluate land use and relate that land use to the kinds of soil and land occurring in the field. In terms of evaluating land management practices we can relate the summerfallow to, for example, the steepness of slopes in the field. However, the soil and land information available in digital soil maps is not generally as accurate as the land use information from satellites images so automated site evaluation must be done with caution.

Satellite images provide us with a "snapshot" of the earth's surface on a given day. This provides an estimate of the land cover on that day. To predict land use we need to make some assumptions as to the significance of the land cover on that date relative to how the land was managed previously or how it will be managed for the rest of the season (Crown et al. 1995a). For example a stubble (80-90% residue) covered field in May tells us that the field was cropped the previous season, but not much about land use for the current season. If we can observe the same field in mid June and it still covered with stubble (some green) we still don't know if it is summerfallow or direct seeded into stubble. If the stubble is still visible in July, with little green, then it is probably fallow (either low disturbance tillage or chemical fallow). If the field is green in July it could be weeds or crop. If it is bare in July it is fallow. If the field is bright yellow in early to mid July it is canola (as soon as the flower is gone it looks like just green vegetation from a satellite). By mid September stubble cover could be harvested crop or well managed fallow. By October bare soil could be fallow or fall cultivation. Thus, in order to determine land use we need several images throughout the season and the dates these land cover changes occur varies in different parts of the province

and changes over time. The results of land use analysis for a township near St. Paul, Alberta are shown in Fig. 1.

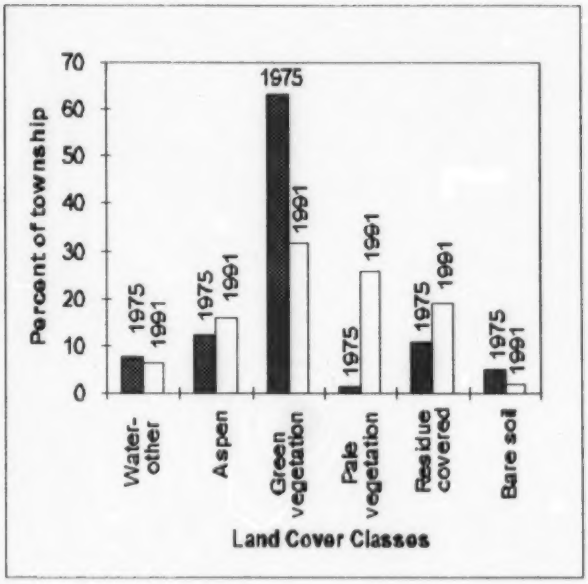

Fig. 1. Changes in land use between 1975 and 1991 near St. Paul Alberta.

Constraints

Given the need for imagery on specific dates in order to estimate land use, cloud cover can severely hamper the analyses. The Landsat Thematic Mapper (TM) passes over a particular area of the earth once every 16 days. If the area is cloud covered at that time suitable imagery cannot be acquired and information critical to land use determination is lost. For example, to detect canola it is critical that satellite imagery be acquired during the period of full bloom, usually 10-14 days in early to mid July. There is evidence that satellite based RADAR imagery could be used to "see through" the clouds for some aspects of land cover mapping (Brown et al. 1993), but at the present time enough imagery to do the job is 3 to 4 times as expensive and the ability to identify specific crops and land cover using current radar satellites is inconsistent.

Because satellite imagery records information about every piece of the land surface in parcels as small as 30 m x 30 m (pixels), and it takes 2 to 4 or more image dates to determine land use classes, the total amount of data is considerable when we want to study a farmer's operation. If we wish to analyze the land use information for the entire prairies, such as we might want to do for an assessment of agriculture's contribution to the greenhouse gases, the amount of data is enormous. We have estimated the cost of imagery alone to be

over $500,000, plus the effort to analyze that amount of data. Therefore, to be useful the data must be generalized, "scaled-up", so that summary statements can be made about a few classes for the prairies. In this process the spatial link between the land use data and other natural resource data is frequently lost (if there happens to be other detailed natural resource data to which it could be linked). These promising remote sensing techniques provide very useful and detailed data. However, for a prairies wide study it is much like using a sledge hammer to drive a tack. There is a need to explore the possibility of using sampling techniques in generalizing land use information for the prairies.

Questionnaire Data

Statistics Canada's Census of Agriculture, collects data that has potential for evaluating land use. The census is undertaken every 5 years through questionnaires to all farmers in Canada. In order to maintain the anonymity of individual farm information the data is aggregated before being released. Custom aggregation, to summarize data on natural resource areas designated by the researcher, can be undertaken by Statistics Canada personnel for a fee, provided that confidentiality requirements are met. This custom service has recently become expensive. The standard data with which we have worked is aggregated to provide summaries reported on the basis of Enumeration Areas (EA). These summaries based on arbitrary geographic areas, do not lend themselves to analysis of naturally defined spatial units such as physiographic region or soil-landscape units. Researchers at the Centre for Land and Biological Resources Research (Hiley et al. 1989) have developed a method to relate Census EA data to natural resource data. A similar procedure was used to build a national database of agricultural census data summarized for Soil Landscape of Canada (SLC) (Shields et al. 1991) polygons. Thus we have the ability to analyze this data to estimate land use in each of the SLC polygons on the prairies, and relate that land use to land and soil data. Trends from census data indicate that for the 10 year period from 1981 to 1991 in the vicinity of Vegreville, Alberta the relative amount of wheat has remained fairly constant, the amount of canola has increased 2 to 3 times, and the amount of summerfallow has decreased by 1/3 to 1/5 (Huffman 1995, unpublished report).

The Agricultural Financial Services Corporation (Alberta Hail and Crop Insurance Corporation prior to 1994) and counterpart agencies in Saskatchewan and Manitoba collect data on land use which can assist in evaluating sustainable farming practices. Alberta Financial Services Corporation, in 1991, recorded data on 40 to 60% of the land, which we considered sufficiently large to justify the use of the data in evaluating land use trends. These data reveal a general decrease in summerfallow, throughout much of Alberta, between 1975 and 1988 (Huffman 1995, unpublished report). It also documents the smaller amounts of summerfallow in the black soils zones and greater amounts in the brown soil zone. The data also quantifies significant increases in canola seeded into stubble between 1976 and 1988.

Census data and AFSC data, because of the need for confidentiality, can not be assigned to very specific tracts of land. In general the data can only be assigned to tracts greater than 100 km^2 (40 mi^2) (Huffman and Unrau 1995). This limits its usefulness to decisions about land areas the size of counties or larger. However, information from questionnaires about the areas of land fertilized or treated with herbicides, or the amount of

manure produced or yields can not be detected by remote sensing. Census data is only available every 5 years, so yearly analysis is not possible. The census data is standardized and thus comparisons over 15 to 20 years are readily made.

Integrating Databases and Methodologies

To verify the accuracy of land cover estimates using satellite imagery it is necessary to drive the roads and record the land use in selected fields the day the satellite image is recorded. Smith and Major (1995, unpublished report) have shown that satellite data is reliable for detecting several land use classes. We only sample a portion of the population of the satellite image when we "ground truth" the land use.

Marciak and Spiess (1995, unpublished report) and Crown et al. (1995b) have shown that land use in samples of, a population defined by a physiographic unit, are quite similar to (strongly correlated with) the measured land use in the entire physiographic area. Marciak and Spiess (Table 1) have shown that samples from a portion of a Land System (Brierley et al. 1992) in the County of Stettler faithfully represent the whole land system. Table 1 from Crown et al. (1995b) shows that land use in a sample of a SLC population is quite similar to the population. These observations indicate that we could employ a technique using satellite imagery to identify land use in selected areas chosen as samples of larger physiographic areas and extrapolate the result to the entire area.

Table 1. Appropriateness of extrapolated land cover classifications made at a township level (Township 40, Range 19) to an entire land system for 1988.

Land Cover	Projected Township Values	Actual Values Land System 1
Bush	19%	21%
Pasture	28%	25%
Forage	4%	7%
Crop residue	4%	5%
Cropping	28%	30%
Bare soil	12%	9%

Crown et al. (1995c) have compared the values for land uses in several SLC polygons as estimated from both satellite and census data. The data suggest that many of the fields that were considered "bare" summerfallow in the census data had enough vegetation or residue to be classed as residue covered at the beginning of August, 1991. This also suggests that residue has been maintained providing some protection throughout much of the summer on the "summerfallow land". Thus we are able to add to census land use information in a SLC polygon based on a sample provided by the satellite data.

Importance of Land Use Information

Land use information is a useful indicator of how well we are managing the land resource. There are a number of process models (WERM, WEPP, EPIC) that quantity the relationship between land use/land cover, climate, slope, soil type to predict the changes in soil quality. Things like slope and soil type are fairly static and can be successfully portrayed on maps. We can also attach general climate parameters to those maps. Then using appropriate weather data and consistent land use data we can predict rates and direction of change in soil quality. This technique allows us to quantify changes that are occurring slowly, but that will impact our children or grandchildren. *In situ* monitoring techniques require that we take measurements over 25 to 50 year periods to document some of the predicted changes. Models allow us to take corrective measures much sooner than that.

Marciak and Spiess (1995, unpublished report) have shown a technique whereby they can relate decreases in summerfallow (Fig. 2), for example, to land systems in the county of Stettler that are more gently sloping and increases in summerfallow to land system with more steeply sloping soils. Thus they are able to evaluate the probable impact of the land use changes on agricultural sustainability and target the information transfer activities to where they are most needed.

Current Activities

One of our goals was that "the methodology" developed should provide techniques applicable to timely monitoring of the management practice changes for the entire parkland. We need an efficient, cost effective and appropriately specific method to monitor land use change. Satellite techniques were shown to be expensive and more detailed than necessary to provide an assessment of the entire area. Questionnaires were shown to be useful but sometimes did not reflect some of the changes that were taking place. We have also shown that can could relate land use information to differing physiographic regions by subsampling those regions and extrapolating those subsamples to the entire region.

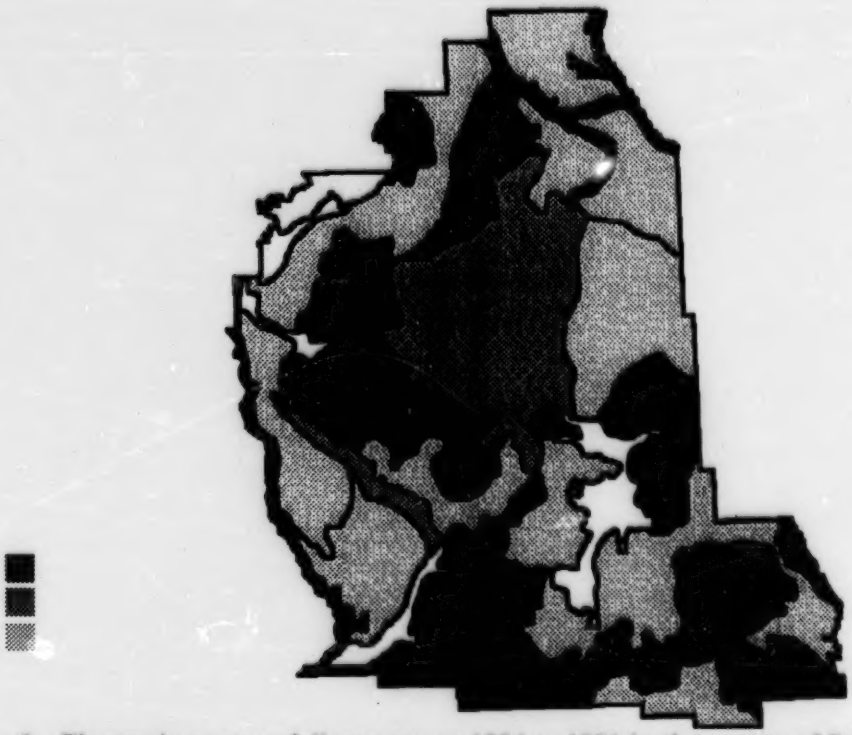

Fig. 2. Change in summerfallow acreage 1986 to 1991 in the county of Stettler.

In the spring of 1995 we initiated a study that we designed to test a procedure for grouping SLC polygons into larger "conservation areas". The census information will be used to characterize various land use classes in the "conservation areas". The validity of these land use assignments will be checked using satellite imagery on sample areas within each of the "conservation areas". Ground data pertinent to the satellite imagery was collected this past summer and will be used to check the accuracy of the sampling approach. This procedure will allow us to augment census data with more specific land use data from satellite images and to benefit from census data that can not be observed by remote sensing. We expect to have a defensible, quantifiable technique to periodically evaluate land use on the prairies and thereby monitor rates of change in the sustainability of land use practices.

SUMMARY

We have demonstrated the strength and weaknesses of remote sensing to monitor land use changes in several parts of the prairies. Questionnaires, such as Census and Alberta Financial Services Corporation data, can provide useful information in monitoring land use over large areas. These two techniques when combined and linked to physiographic data such as soil surveys, climatic data and weather data are powerful tools in evaluating sustainability of our land management practices and their contribution to greenhouse gases.

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A SYSTEMS APPROACH TO TECHNOLOGY TRANSFER CHALLENGES AND OPPORTUNITIES

Glen Hass, P.Ag., Organization Management Services, Saskatoon, Sask.

A HISTORICAL REVIEW

Technology transfer or extension as it has traditionally been referred to, has played a major role in assisting agriculture in Western Canada. The prairie region was settled in a very short period of time. These settlers came from diverse backgrounds. Some had previous agricultural experience while many new nothing about agriculture. Few were really prepared for the harsh realities of farming the Canadian prairies.

From the very early settlement period both the Federal and Provincial Departments of Agriculture became involved in extension activities. The Government of Canada established several experimental farms in the west. One function was to hold field days to demonstrate new crops and livestock suitable for prairie conditions.

In Saskatchewan, the University of Saskatchewan was given the mandate to provide agriculture extension throughout the province from its Extension Department within the College of Agriculture. It wasn't until 1947 when legislation was passed to establish the Agricultural Representative Branch within the Department of Agriculture, that the province became more involved. Such legislation had been passed in Alberta and Manitoba much earlier.

Even with the establishment of "Ag Reps," a systems approach to agriculture extension remained and has been continued with Agriculture and Agri-Food Canada, Research Branch, PFRA, provincial departments of agriculture and the universities still providing technology transfer services in various ways.

THE SYSTEM

Technology transfer is a process but is often wrongly perceived to be a product. In reality, technology transfer should be viewed in terms of a market system where there are manufacturers (researchers), wholesalers (professors), retailers (extension workers) and consumers (farmers). This market system has not changed nor is it likely to in the near future. What will change is the process.

To further explain this, it is useful to identify the system as being composed of providers, deliverers and users. Again, it should be pointed out, this system was essential and was in place when agriculture was introduced to the prairies some one hundred years ago.

While the system will continue, the process will change. As yet, the type of change that will occur is unclear.

SCENARIOS OF CHANGE

Scenario One - Things Will Remain the Same

This scenario is not possible. Changes are always occurring. The rate of change will likely increase. Past methods of technology transfer will quickly disappear.

Scenario Two- "Privatization of Technology Transfer"

Privatization of technology transfer is not a new concept. In 1987, England started privatizing with four types of services: subscription, consultation (by the hour), product services (ie. veterinary and marketing), and direct contact. Since 1992, it has moved rapidly to total privatization with the expectation that by 2000 it will be total cost recovery. Other countries have also moved in that direction. Ireland, the Netherlands, Denmark, New Zealand and Australia have all experienced moves toward privatization. The degree to which this has assisted agricultural producers is debatable. One thing is for certain, those who can afford to pay receive a greater amount of service. One other trend which can easily be identified is that the increase in farm size has been greater and more rapid in countries where services have been privatized. While in most of the countries where privatization has taken place, the agencies providing services are still within the government, there is an increasing likelihood that these services will be provided by the private sector as private consulting firms become more firmly established.

The challenge for providers (researchers) will be to develop the information demanded by these deliverers who are driven by the supply-demand forces in the market place.

The opportunity exists for public money to be almost totally channelled into research both basic and applied thus producing the product for sale.

Scenario Three - The Information High way

There is an increasing fascination with technology. The rapid trend to establishing home pages to provide virtually unlimited amounts of information to the users is now preoccupying many who were formally front line extension workers. The belief that providing information by technology will solve technology transfer problems, may be flawed. The most important consideration for sound extension practice has always been the quality of information (product) and the ability to use it. The challenge will be to make sure that the delivery portion of the system is in a usable product form. Assuming that because it is available on Internet, it is good information, that it will be used, that farmers have the time to download it, etc., etc. may be dangerous.

What is and will likely continue to drive this scenario is the belief that technology solves all problems. It will also be driven by the fact that dollars can be saved as "deliverers" are eliminated from the system.

The opportunity does exist to provide access to new information quickly. This may be the way that "retailers" can provide the service to farmers in a more effective way.

Scenario Four - Corporate Production Units

The growing trend to larger production units may soon make this scenario common. Where units are large enough to employ their own researchers and extension workers (managers) the technology transfer system will be a closed system. These large units will produce their own information based on the research required on their own farms. They will be large enough that conditions will vary from one part of the farm to another. In this system, information will not be "public" but will be protected to gain market advantage. Providers, deliverers and users will all be within the production unit. The willingness to share would be similar to Ford and General Motors!

The challenges for those involved in public research will be to get funding to carry on any form of agricultural research. In this scenario, most public funds will be allocated to the regulatory function of government.

The opportunity will come from the need for contract research where specialized information is required to resolve a particular problem or issue. Corporate units are likely to pay for this type of research.

Scenario Five - A Research Cartel

As the value of information as a product is realized and with shrinking funding allocated to research, there will be a tendency to use a "research for profit" model. This could be a very lucrative business. Using information patents is just now beginning. There have been cases where information from research has been sold. Copyright is a form of this which is now being treated a great deal of care.

Another business principle which could easily be applied is supply-demand. Research units could easily withhold information until such time as it is very valuable. It could then be released at a huge profit. For example, a vaccine could be developed to control a specific disease. It could be held until such time as the disease has virtually eliminated a certain type of livestock practice. It would then be released with dramatic effect.

This scenario may well become a reality if funding for research continues to be reduced. The only alternative will be to have a research for profit system. If it is to be self sufficient research units will give consideration to this scenario.

The challenge will be for users to make sure that there are funds available for research. There are now check-offs in place to assist in funding research and technology transfer.

The opportunity is for the strengthening of stakeholder alliances to ensure that the system is funded.

SUMMARY

Changes in the technology transfer system will escalate at an even greater pace than in the past decade. This will be as a result of reduced government funding. The result will be a move to one of various possible scenarios. As yet, it is impossible to predict what the new process will be. The new technology transfer process will be determined as a result of which component of the system emerges with the power to take control. Will it be providers of information as a result of using information as a saleable product? Will it be deliverers who can control the process by controlling distribution? Will it be users who have the power provided by the fact that they control the whole process from research to use on their own farms? Our final unknown factor is the role of the public. How will society react if any of these gain control? The consumer may well be forced to pay for food at a much higher rate than what now is in place.

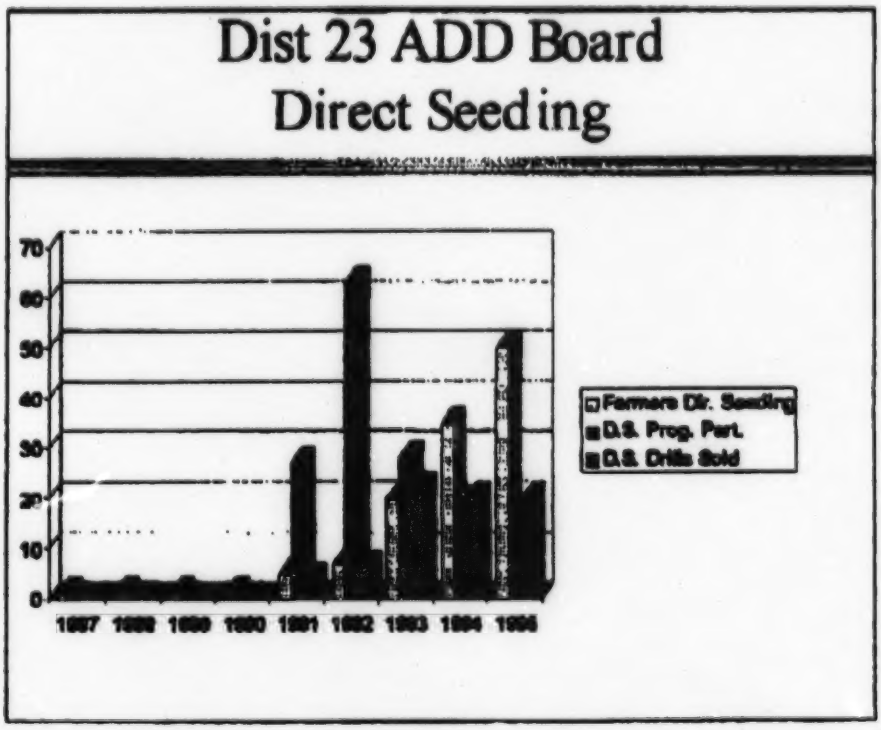
A Farmers Perspective On Bringing Conservation Technology To The Farm

John Bennett, Biggar, Sask.

Farmers assume a huge amount of risk as a necessary part of their business and are unlikely to change to a system they view as a "high risk strategy," the average farmer will take the wait and see approach before venturing from the norm. Regrettably most use the "across the fence line" method of accessing different ideas or practice.

At the risk of appearing vain and self serving I would like to lead you through the changes in our farming area. In talking to farmers from other areas I think a clear pattern emerges.

Direct seeding or Zero-till currently offers the best prospect in reducing erosion, or dare I say possibly reversing soil degradation.



Here is a graph that shows the adaptation of Zero-till in our area. The graph spans a period of eight years. It uses the number of low disturbance drills with on row packing as a yardstick of change. If acres were used as a yardstick the graph would start at twenty acres in 1987, and reach close to 100,00 acres in 1995.

This exponential change is largely driven by economic factors. Reducing soil degradation is a desirable side effect that is difficult to quantify in the short term.

Zero-till is being adopted as a risk management tool. The limiting factor in crop production here is moisture, a system contributing to moisture efficiency becomes a risk management tool. If a conservation tillage system demonstrates profitability acceptance will follow.

In hindsight I think there are three stages involved in the process leading to acceptance that help explain the graph.

I will try to be as objective as possible in explaining the stages.

STAGE ONE is what I call the "fringe loony" stage where the first farmer jumps in. These fellows are usually idealistic, vain, and certain there is a better way. Bankers are warned to be wary of these farmers because of the risk they pose to lending institutions. An example of how early adapters are perceived is best illustrated by the following anecdote. Early on I walked into the coffee corner at the local implement dealer, the place went from an animated buzz to a dead silence. A clear indication of how uncomfortable they were with my change in farming practices. At this time information and research was rather limited. At four years this period was longer than necessary but 1988 was a drought year. During adverse times farmers retrench and retreat to conventional wisdom.

STAGE TWO - 1991 brought in major changes. Two more no-till seeding rigs were purchased. What was more important was these operators were observant, thoughtful and respected. Great strides were made with the pooling of information and exchange of ideas. The fundamentals were clear and the subtleties were starting to be explored and integrated. Zero-till started to be viewed less skeptically by the general farm population.

Another stride towards general acceptance was a program run by the District 23 ADD board with a leased No-till drill. This is shown on the graph and ran four years. This drill was rented to area farmers at a subsidised rate for eighty acres. Some sound advice was also given on the fundamentals of No-till. This program created a solid base of farmers who had a sense of ownership of conservation tillage. Each farmer could compare their own Zero-till plots with their own conventional till plots. They could also objectively compare these fields with the more established Zero-tillers. Remember the term "risk management" here. Good applicable research data was coming on stream and as one farmer stated "you can't open a farm paper now without something on direct seeding falling out."

What is important is that to bring conservation tillage systems into general practice farmers must feel they have ownership of the concepts and ideas. In this period I remember one farmer whose neighbours were all conventional tillage stalwarts saying "I don't care what anyone thinks I'm just going to go No-till."

At this time the SSCA (Saskatchewan Soil Conservation Association) were putting on some excellent well attended conferences. These had superb blend of researchers and farmers with a shared vision of the ideal. Machine and chemical companies could see the profit potential and started enhancing the tools available to direct seeders.

The THIRD PHASE in our farming area probably started in about 1994 when Zero-till had achieved general acceptance as a viable alternative system of farming with some advantages but much complexity. The anecdote I would illustrate this with happened in the local implement dealership where the discussion turned to some severe water erosion the previous week. The final words come from the sales manager (a man with a profound understanding of prevalent farmer attitude) who said "Those summer fallow fields were sure ugly. What an unnecessary waster of topsoil." When most people nodded in agreement I was certain Zero-till was receiving acceptance as a risk management strategy with positive side effects.

Areas such as Indian Head with its earlier "fringe loonies" and a good research base working closely with farmers is farther along this acceptance model. At Indian Head I suspect Zero-till is becoming the dominate farming practice rather than the acceptable alternative it is near Biggar.

This acceptance is because conservation tillage systems are viewed as a means to profitability and a risk management strategy. Reducing soil degradation is viewed as a long term benefit.

There is a direct correlation between the proximity of a research station and the acceptance of No-till in an area. I think a study of Scott and Indian Head would verify this. The partnership between farmers and researchers based on mutual respect and fuelled by ideas will make conservation systems a profitable and sustainable reality more quickly. Unless research is done in a similar soil and climate area, farmer's will question the credibility of the results, and be reluctant to apply them on their own farm.

Research must be applicable, concise, and readily accessible if we are to integrate it into our farming systems. Research must be applied by a farmer and seem to be profitable to others before it will be considered acceptable in the general farming community.

Future Direction of Conservation on the Parkland

George W. Clayton
Agriculture & Agri-Food Canada, Beaverlodge

Conservation and PARI came about due to the recognized need to manage our soil resource and assess the impact of greenhouse gases have had on the environment as discussed by Wayne Lindwall. Gordon Dorrell gave us a global perspective of sustainability in his address which indicated that many sustainable civilizations can and do exist. Doug Penney described in his presentation that sustainable land management was a non negative change in the stock of natural resources. It appears that tools or technology may change but the goal or objective of sustainability is the same. A critical mass of conservation thinking has occurred, indicated by this and many other conservation meetings.

What do we know about conservation? Many talks at this meeting emphasized the need for packaging information. Computer technology (Decision Support Systems), information brokers and PARI farms were discussed by Murray Bentham, Glen Hass and Wayne Lindwall as means of packaging information. Packaging accelerates the transfer of technology. There is an incredible volume of information available at this meeting (PARI factsheets, poster presentations, speakers) produced by developers that hasn' t been packaged by wholesalers/retailers for consumers.

Wayne Lindwall described the pitfalls of new technology in that A for every mile of highway there is two miles of ditches@. Consumers of information need to know if they are on the right highway or even in the right ditch. We need a map to make sure that we are on the right highway and heading in the right direction. Developers of technology draw this map. Radial tires and speed limits are the technologies developed to keep us on the highway. However, sometimes we end up in the ditch. The tow truck is technology that can help us out of the ditch and back on the road. Packaging of information is the map and the tow truck of conservation.

Where do we go from here? The future direction of conservation will integrate the environment with economic survival. Guy Lafond described areas of future research in crop production under conservation tillage that are required now to insure this integration. Packaging of current information and developing innovative new technologies will obviously be important as new adapters embrace conservation technology and innovators seek answers to new questions.

Ken Eshpeter stated a need and willingness to work with research scientists on his farm to solve the challenges of direct seeding that he encounters. Requests such as these are not unreasonable and can be accomplished through Applied Research Associations, provincial government research/extension activities and federal government research scientists as well as PARI farms and on-farm demos. Producers of technology need to validate their technology at the consumer level which aptly describes the theme of this conference, "Bringing Technology to the Farm"

Lee Moats and Guy Lafond gave us a perspective of conservation in terms of land use, integrating productive land with not so productive land. The forces that prevail in decision making were aptly described by Guy as economic survival and environmental awareness. Conservation principles are not static and changes will occur according to the way we perceive ourselves, our principles and our values and intimately connects conservation with quality of life. These principles and values will determine how well we succeed. Each individual may need to develop their own personal social contract with the environment. This contract would only be feasible if economic survival is insured.

Technologies develop out of need, whether the need be production or environmentally oriented. Some examples of these needs follow , some of which were presented here today.

Lee Moats described the nesting habits of ducks and equipment that would minimize the damage to their habitat in forage fields and in particular the effect of cutting forage later in the season. As forages/livestock are valuable tools in conservation systems, crop types could be developed that have good nutritional value later in the growing season, merging economic survival and wildlife friendly practices on the same unit of land.

Crop production needs to be evaluated in a systems approach. We do not have a series of individual years that are unrelated. Systems involve crop rotations, fertilizer management and weed control that impact on the relationship between plant, soil and soil microflora interactions. These interactions impact on future fertility, organic matter and weed dynamics.

The value of herbicide tolerant crops has been vaguely mentioned at this meeting. These crops could be valuable in our high-tech tool kits for conservation enhancement. However, utilizing a tool has its consequences. Thus we need to consider the judicious use of herbicide tolerant crops as a means of reducing herbicide use. Otherwise, the

unplanned use of herbicide tolerant crops could result in an increase of volunteer crops. This result could lead to higher use of costly herbicides and possibly back in the direction we came from.

Other high-tech tools such as GIS and precision farming described by Murray Green and Doug Penney will enhance economic survival and make positive changes to the landscape. These technologies are powerful tools for conservation enhancement. However, developing technologies will need a conservation plan in the early stages of their development. GIS systems to date have put 28 satellites/orbital planes in space. Without a conservation plan there may be a conference such as this in 25 years to discuss how to clean up the high tech garbage in space. Economic survival without a conservation plan is a highway that eventually leads to reclamation. Is this not what practicing summerfallow has accomplished and why we are here today?

Conservation in the future will be similar to that in the past and present. When conservation is the goal, the objectives to achieve that goal remain the same. However, the tool kit to reach the goal is forever changing. Technology will be developed, packaged and transferred to consumers in a more effective manner.

When driving down that highway we need to look at the road ahead, confident we know where we are going. Farmers like Ken Eshpeter know what they need and are constantly looking at technologies that will help them succeed. Imagine driving down that highway looking in the rearview mirror. You would see more of the ditch and less of the road. Further development of technologies as described at this meeting, and elsewhere, is the road ahead. Packaging the technologies for use by the consumer will help keep us on the road and our eyes off the rearview mirror.

FUTURE DIRECTION OF CONSERVATION ON THE PARKLAND: PANEL DISCUSSION

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It is difficult to determine the future direction of conservation in the Canadian Parkland unless a critical assessment of previous and existing conservation programs is undertaken. Several key questions need to be addressed-- how effective, how accessible and how adaptable have current and past conservation programs been?

About 31 percent of the cultivated acreage in Saskatchewan was reported to be under some form of conservation tillage. This suggests good adoption of conservation practices, however conservation practices have been most adopted in the drier Brown, Dark Brown and Thin Black soils. How adaptable are practices common to these regions to wetter Parkland areas? Assessment of gaps in knowledge is also important. Improved water management and efficiency has been identified as a driving force for successful adoption of conservation tillage. Increased water conservation and water use efficiency has also been identified as an area requiring more research. However, Parkland areas do not normally suffer from the same moisture constraints as other regions. Residue management, fertilizer placement, weed management and crop diversity may be of more concern in the Parkland.

One of the major goals of the Parkland Agriculture Research Initiative (PARI) is the provision of timely, accurate and accessible information to enable Canadians to make environmentally sensitive decisions. Presumably, increasing knowledge and accessibility to conservation practices of farmers in the Parkland region will help achieve other PARI goals of: contributing solutions to greenhouse gases, encouraging adoption of soil and water conservation technologies and reducing summerfallow. This workshop, the PARI Factbook, and the computerized support systems developed through the initiative illustrate how successful the PARI program has been in developing knowledge and accessible information. However, that alone does not mean greater implementation of conservation practices in the Parkland.

PARI is a link in the information chain between the researcher and farm, one of the many links in the process of technology transfer. PARI has, and will continue to have a positive influence on the adoption of conservation in the Parkland. However, the information chain could be strengthened so that it is more of an implementation chain.

Commitment to research is essential if conservation in the Parkland is too become more common. Many questions are unanswered or only partially answered. And, it is important the right questions are being asked. Those asking the questions, and those finding the answers, need to understand what hinders or prevents adoption of research findings from other areas. Farmers need to be involved more closely with the researcher in helping identify the problem and possible solutions.

Greater involvement of farmers necessitates better communications between everyone involved. Researchers and farmers need better lines of communication. Not only do researchers and farmers need to talk, but extension and research needs to work closer together. In like manner, extension and the farmer need closer involvement. Great implementation of conservation practices will occur when farmers are more involved in the development and extension of information.

Partnerships have become very important in recent years with funding cutbacks in the public sector. Conservation efforts would benefit from expansion of industry partnering and perhaps developing relationships with other commodity groups or associations. Most industry partnering has focused on financial support of industry to researchers, but other areas should be explored, particularly in extension. Partnerships with retail agribusiness may be a valuable method of delivering conservation information and advice to Parkland farmers. Partnering with prominent farmers for demonstration or research would also help ensure the direction of conservation in the Parkland.

In summary, conservation in the Parkland has a bright future. The PARI program has provided a strong foundation and a good start. Appropriate, applied research, better communications and expanded partnering will contribute to a strong finish and help guarantee conservation efforts in Black and Gray soils will be successful.

Parkland Agriculture Research Initiative (PARI): Where Should We Be Headed?

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Where Have We Been? ... A Brief Glimpse Backwards

Wayne Lindwall put it well yesterday when he said "how do we know where we're going if we don't know where we've been?" ... so let's spend a few minutes looking at a few examples of where the problems of excess tillage and summerfallow have come from, how they have been recognized and what approaches have been tried to solve those problems.

While investigating the background of these two practices, I found that the Federal Department of Agriculture played a role in developing and promoting intensive tillage and summerfallow. In 1890, Angus MacKay, Superintendent of the Indian Head Experimental Farm wrote the following in the Farm's Annual Report:

> "Summerfallow, however, has several great advantages -- causing a better yield, it can be got ready when no other work is on hand, and at the same time is in the very best condition to hurry in the crop in the spring, which is one of the things absolutely necessary for success here .... by ploughing early and repeated cultivation, there need not be the slightest doubt. Land ploughed last year, before 1st of July, bore abundant evidence this year of the wisdom of early work. A Randall harrow was found to be the most effectual implement ... but it was necessary to use it often and allow nothing to appear very far above the surface."

Mr. McKay's comments continue to describe the short term value of summerfallow and intensive tillage as practical tools for crop production on the Prairies.

After the "dirty thirties" the Federal Department of Agriculture realized that the practices of intensive tillage and summerfallowing created significant problems with soil erosion, even in the Parkland region of the Prairies. M.J. McPhail, Superintendent of the Melfort Experimental Station wrote the following in a Progress Report in 1946:

> "Soil drifting occurs here every season, but particularly heavy losses were suffered during the springs of 1940 and 1941 .... a depth of several inches was blown off parts of a large percentage of summerfallowed fields, and a few stubble fields .... Damage from gullying and sheet erosion also takes place each spring when the snow melts, but during the springs of 1938 and 1940, losses from this cause were much more severe than usual. Furthermore, heavy rains during these same seasons washed out deep gullies on many summerfallowed fields.....

> What will our fine large fields be like fifty years hence if destructive processes such as shown above [photo of sheet erosion] are allowed to continue?"

Scientists in the Federal Department of Agriculture did not, however, confine their activities to observing the problems, they also worked at finding solutions to the problems of declining soil quality. They realized that the solutions were not simple; no single technology or practice would work for all farms or farmers. Yesterday, Murray Bentham said, "farming is complex; conservation farming is very complex." R.M. Hopper, Superintendent of the Brandon Experimental Farm said something similar in his Progress Report in 1947:

> "... the choice of cropping system ... must necessarily be influenced by the following limitations and requirements:
>
> a) location of farm in relation to markets
> b) size of farm
> c) climate
> d) kind and texture of soil
> e) kind and prevalence of weeds
> f) susceptibility of soil to erosion
> g) water supply
> h) native hay and pasture available
> i) numbers and kinds of livestock
> j) power and labour available
>
> No best system of cropping can be generally recommended. While grain rotations met the early needs of farms in Manitoba, systems including grass, legumes, and other crops must be selected to suit the individual requirements of a farm."

Given the way that sustainability and farming systems have been discussed during the last two days, the remarks of Mr. McPhail and Mr. Hopper continue to be relevant.

<u>Where Are We Now and Where Should We Be Going?</u>

PARI's overall objectives of reducing summerfallow and intensive tillage are virtuous. However, the goals for the individual projects within the initiative are diverse. Given the modest resources that are available, PARI cannot afford to be all things to all people; goals must be priorized.

If the overall objectives of PARI are sound, are we making suitable progress toward those objectives? How will we know when the job has been done? The answers to those questions depend on how much summerfallow and intensive tillage is being practiced and how much is acceptable.

Gerry Coen mentioned the use of Statistics Canada data as a monitoring tool (we also saw a software demonstration set up by Ted Huffman and Eric Unrau that portrays that Statistics Canada data in another form). The census information, summarized in the publication "Canadian Agriculture at A Glance" show that summerfallow occupies a very small portion of the land acreage in the Parkland region. Therefore, I suspect that summerfallow intensity is not a significant problem, outside a small area in East Central Saskatchewan. The same census information, however, shows that conservation tillage is not widely practiced in this region. Therefore, conservation tillage should probably become the sole focus of future efforts.

If we assume that summerfallow and/or intensive tillage should be reduced further, what are the factors that limit adoption of soil conservation practices? What roles do research and technology transfer play in overcoming those limitations? To answer these questions, we must recognize that soil and crop management decisions are made by farmers, not machinery or computers. As Glen Hass said, we are dealing with a human process, not exclusively a technological one.

The ultimate measure of PARI's success or failure will be measured by the extent to which farmers change their behaviour. I will spend a few minutes describing three steps in a farmer's decision-making process and the role that PARI is playing or could play in promoting conservation practices through those steps.

Awareness of a problem is the first step toward solving it; awareness of the solution is the next step (ie. you cannot sell a solution before you have sold the problem). PARI's efforts to monitor, investigate and document soil conservation problems and solutions are helpful for this stage. However, many farmers are unaware of PARI's efforts.

Education is the second step, but should not be focused only on producers. Scientists, extension staff, agribusiness and farmers must learn from each other about soil conservation problems and solutions. At this point I will state my concerns regarding PARI's emphasis on electronic technology. As mentioned earlier, technology transfer is a human process, not a technology. Does the existence of a computer database or expert system constitute technology transfer? Is "high-tech" the most cost effective way of changing behaviour? Costs for technology transfer by various means must be weighed against benefits. Furthermore, we must be careful not to drown the agricultural community with electronic data, while ignoring their thirst for strategic information.

Belief, commitment and action are combined into what I believe is the final step of a farmer's decision-making process, similar to putting on a parachute and then leaping from a plane. I agree with Dan Cornish that soil erosion is not a willful act of farmers, but I do not believe that soil erosion is "usually an outcome of inadequate information" either. Soil conservation requires more than awareness and education; it requires informed commitment and action by farmers and others. To build that commitment, farmers must be convinced that soil conservation practices are technically feasible, economically viable, and consistent with their personal and social values.

The technical feasibility of conservation farming is enhanced by new technology and new cultural practices. Technology creates opportunities for patents and revenue. Therefore, much of the new physical, chemical, biological technology (eg. airseeders, herbicides, new crops) has been developed by the private sector. The important role of the private sector requires that we continue to develop creative alliances between that sector and the public institutions that provide research and technology transfer. In contrast, new cultural practices are not so easily transformed into generators of wealth for those that develop them. The public sector has a valuable "market niche" (to use Glen Hass's marketing analogy) to develop and transfer these practices. However, in contrast to the Murray Bentham's example yesterday, of recommending pesticides to control wheat midge, PARI's efforts should focus on soil conservation issues and cultural practices such as crop rotation to address these issues.

Economic viability is an essential feature of any sustainable agricultural practice. If conservation farming is not economically viable, conservation-oriented farmers will be unable to stay in business. However, economic viability is not the same goal as short term profit maximization; other goals and values are also important in the farm management process.

Social or community values, as described so eloquently by Ken Eshpeter, are some broader values that are important to farmers. Examples of such values include the desire to maintain the quality of the "family farm" for future generations, to maintain the social fabric of rural communities, and to maintain the quality of the environment. Personal comfort, convenience, safety, and simplicity are also examples of non-economic values that are important to farmers. Soil conservation practices should be "packaged" in ways that appeal to these non-technical and non-economic values.

To advance a conservation practice through the steps that I have mentioned requires the combined efforts of many people. A partnership approach is essential. Dan Cornish put it well when he mentioned that people are important to success of any endeavour; we like to stop, get to know each other and exchange information. Exchange of problems, questions and possible solutions among all those involved is important and should involve:

- scientists at Agriculture and Agri-Food Canada, Prairie universities
- public extension staff in the provincial departments of agriculture
- private sector agribusiness
- producer groups (those with access to public or checkoff dollars, or who have political influence will be especially welcome)
- individual producers

Before the partnership can work properly, two myths should be eliminated.

Myth #1 - Technology Transfer is a One-Way Process. We have to move away from simplistic models of one-way technology development and transfer (where scientists give knowledge to extension staff who give it to producers) and towards a multi-directional model of technology exchange. The real process is more similar to a "web" than to a pyramid or a chain. We must show more respect for the contributions of farmers and private industry to the process. This conference and others like it are a step in the right direction.

Myth #2 - A Huge Technology Gap Exists Between Researchers and Farmers. I doubt that there is a huge inventory of good but unpracticed research ideas in the area of soil conservation. Many research ideas, in their current form, are not practical to implement at the farm level, either technically or economically without further refinement. Ray Dowbenko referred to progressive farmers as "early adaptors" rather than "early adopters" -- both terms are equally appropriate, given the amount of adapting that is required in the early stage of developing a practice.

Conclusions

PARI is a good program with worthwhile goals. However, based on my limited observations, I have a few suggestions that might be considered for strengthening the program:

1. Public support for soil conservation is essential and should continue. Publicly financed efforts to develop and exchange conservation practices are worthwhile and should be focused on those issues for which industry funding from agribusiness and producer groups is not available.

2. Refine PARI's goals. PARI cannot afford to "be all things to all people." In consultation with the partners mentioned previously: identify, quantify, then priorize the goals; use some of our monitoring and informational tools to reshape our management of PARI, to focus on more specific regions and practices and to evaluate our successes and failures.

3. Build further on the partnership approach. Include more than just token representation from private industry and farmers in all areas, including setting the direction for research. However, the priorities set above (in recommendation 2.) must be maintained for a reasonable time.

4. Refine the techniques for extension and technology transfer. Remember that these are human processes; do not rely too heavily on electronic software and databases, alone.